



- 1 Hydrogen reacts with oxygen as shown:  $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \quad \Delta\text{H} = -205 \text{ kJ mol}^{-1}$

Calculate the bond enthalpy for the O=O bond using this and the following data.

Bond enthalpies: H-H = 463, O-H = 436  $\text{kJ mol}^{-1}$

Enthalpy of vaporisation of water = +44  $\text{kJ mol}^{-1}$

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- 2 Calculate the enthalpy of formation of propan-1-ol,  $\text{C}_3\text{H}_7\text{OH}(\text{l})$ , given the following data.

$\Delta_{\text{c}}\text{H } \text{C}_3\text{H}_7\text{OH}(\text{l}) = -2010 \text{ kJ mol}^{-1}$      $\Delta_{\text{c}}\text{H } \text{C}(\text{s}) = -394 \text{ kJ mol}^{-1}$      $\Delta_{\text{c}}\text{H } \text{H}_2(\text{g}) = -286 \text{ kJ mol}^{-1}$

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- 3 Calculate the enthalpy of formation of ammonium chloride give the following information.

$2\text{NH}_4\text{Cl}(\text{s}) + \text{Ca}(\text{OH})_2(\text{s}) \rightarrow 2\text{NH}_3(\text{g}) + \text{CaCl}_2(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \quad \Delta\text{H} = +246 \text{ kJ mol}^{-1}$

$\Delta_{\text{f}}\text{H} / \text{kJ mol}^{-1}$      $\text{Ca}(\text{OH})_2(\text{s}) = -987$      $\text{NH}_3(\text{g}) = -46$      $\text{CaCl}_2 = -795$      $\text{H}_2\text{O}(\text{g}) = -242$

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- 4 1.08 g of methanol,  $\text{CH}_3\text{OH}(\text{l})$ , was burned in a spirit burner and used to heat 100.0 g of water in a copper calorimeter. The temperature of the water rose by 38°C. Calculate the enthalpy of combustion of methanol determined by this experiment. The specific heat capacity of the solution is 4.18  $\text{J K}^{-1} \text{g}^{-1}$ .

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